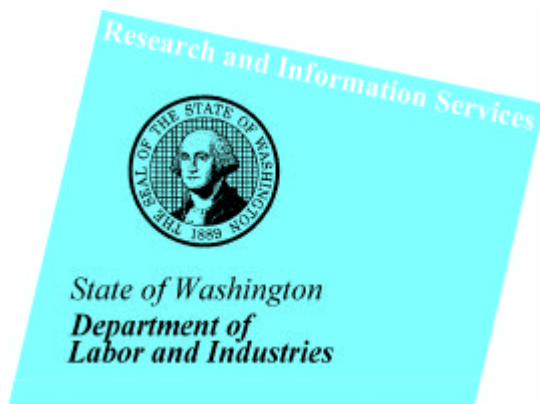


OCCUPATIONAL LEAD EXPOSURE REGISTRY

1996 ANNUAL REPORT



Incorporating data from
May 15, 1993 through December 31, 1996



Occupational Lead Exposure Registry

1996 Annual Report

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List of Definitions and Acronyms

ABLES.....Adult Blood Lead Epidemiology and Surveillance program of NIOSH
ALERT.....Adult Lead Exposure Reduction and Testing project conducted by SHARP
BLL.....Blood lead level
BOC.....Bureau of Census
DOH.....Washington State Department of Health
CDC.....Centers for Disease Control and Prevention
L&I.....Washington State Department of Labor and Industries
NIOSH.....National Institute of Occupational Safety and Health of CDC
OSHA.....Occupational Safety and Health Administration
Registry.....Occupational Lead Exposure Registry
SHARP.....Safety and Health Assessment and Research for Prevention Program of L&I
SIC.....Standard Industrial Classifications
WAC.....Washington Administrative Code
WISHA.....Washington Industrial Safety and Health Act
µg/dl.....Micrograms per deciliter is the unit of measurement for blood lead concentrations

Executive Summary

This report summarizes the reporting of adult blood lead levels from May 1993 through December 1996 to the Occupational Lead Exposure Registry (Registry) maintained by the Washington State Department of Labor and Industries. The Registry's purpose is to foster activities that prevent lead overexposure and poisoning in Washington workers. Through December of 1996, 12,694 individuals had a total of 16,959 blood lead test results recorded in the database. Although the majority of the blood lead levels are in line with the national goal to keep workers' blood lead levels under 25 µg/dl, 5 percent of the cases, representing just over 600 individuals, had elevated blood lead levels. The extent of individual follow-up is determined by the blood lead level itself, with the highest levels receiving the greatest amount and most individualized follow-up. Through this reporting period, just over 400 individuals with elevated levels have been mailed educational material on health effects of lead overexposure and ways to prevent it. Case interviews have been completed for 74 individuals with some of the highest blood lead levels (over 39 µg/dl). Follow-up efforts also extend to the case's health care provider and employer.

The data collected through Registry activities serve a vital role in the surveillance of occupational lead overexposure and poisoning in Washington State and contributes to national surveillance efforts. No other agency in the state collects information on adult blood lead levels. The information has helped us identify industries and occupations in which workers are experiencing overexposures to lead so that prevention efforts can be appropriately directed towards the problem industries, occupations, and workplaces.

Introduction

Lead is widely recognized to be associated with damage to the human nervous, blood-forming, and reproductive systems, as well as damage to the kidneys and increases in blood pressure. Lead is used in many different industrial and occupational settings and is involved in many diverse job tasks. Based on the adverse health effects caused by exposure to lead, the United States' Public Health Service set a national goal for the year 2000: Objective 10.8 is to "eliminate exposures which result in workers having blood lead concentrations greater than 25 µg/dl of whole blood" (US HHS, 1991)¹. The prevention of lead poisoning in Washington State, and for the country as a whole, is an important public health goal because of the seriousness of the adverse health outcomes associated with lead poisoning, the preventable nature of the condition, and the potential for minimizing health effects, e.g., with early detection of lead poisoning.

The purpose of the Occupational Lead Exposure Registry (Registry) is to foster activities to prevent lead overexposure and poisoning in Washington workers. The Registry serves a vital role in the surveillance of occupational lead overexposure and poisoning in Washington State. It is a central repository for the information collected from laboratories throughout the state (and the country) for Washington State residents, and it is the only repository where these data are reviewed and analyzed. This information assists in identifying industries and occupations in which workers are experiencing overexposures to lead. Education and prevention efforts directed towards the workers, workplaces, industries, and occupations stem directly from the information obtained through the Registry.

As of May 1993, Washington Administrative Code (WAC) 246-100-042 requires any Washington State laboratory which performs blood lead analysis or any organization or individual that sends specimens for blood lead analysis to an out-of-state laboratory to report the results of these tests for Washington residents to the Washington State Department of Health (DOH). The complete regulation is shown in Appendix A. DOH's Office of Non-Infectious Conditions Epidemiology maintains the Childhood Blood Lead Registry and forwards test results for Washington residents ages 15 years and older to the Safety and Health Assessment and Research for Prevention (SHARP) program of the Washington State Department of Labor and Industries (L&I), where results are maintained in the Registry.

¹ Micrograms per deciliter (µg/dl) is the standard unit of measurement for blood lead concentrations.

The WAC for blood lead reporting was initially established as a three year temporary requirement effective May 15, 1993 through May 14, 1996. During late 1995 and early 1996, there were technical and public hearings held concerning the rule, and in the Spring of 1996, the Washington State Board of Health renewed the rule for an additional three year period beginning on May 15, 1996. The WAC will expire on May 14, 1999 unless a permanent or another temporary rule is approved.

Current Status of Blood Lead Level Reporting

Blood lead levels (BLL) for adults are currently reported in at least 25 states. The state programs submit their counts of blood lead test results to the Adult Blood Lead Epidemiology and Surveillance (ABLES) program of the National Institute for Occupational Safety and Health (NIOSH), part of the Centers for Disease Control and Prevention (CDC), to assist in the national surveillance effort investigating elevated blood leads in adults (CDC, 1997). While reporting of BLLs for children is well established across the country, there is increasingly stronger support for making adult BLLs reportable because adults, like children, may experience severe health effects from overexposures to lead. Therefore, there are compelling arguments for having BLLs for people of all ages added to the national list of notifiable diseases (or conditions) in the interest of public health.

The Council of State and Territorial Epidemiologists and the Association of State and Territorial Health Officers state that laboratory-based reporting is an efficient system to accomplish the goal of reporting blood lead levels (CDC, 1995). Unlike many conditions which require that either health care providers or hospitals notify the appropriate health offices when they treat a case with a reportable condition, blood lead reporting requirements typically require the analytic laboratory performing the tests to report results. Instead of receiving reports from many different offices in a variety of formats, laboratory-based reporting allows the relatively small number of laboratories that conduct a specific analysis to periodically submit their test results. This arrangement should not over-burden laboratories (as they also generate a report to send to the health care provider who ordered the test) and it makes it much more efficient for the organization collecting the reports because there are relatively few parties involved and many fewer reporting formats to handle on a day to day basis.

In Washington State, the Board of Health has approved a plan to make selected occupational diseases reportable (Washington State DOH and L&I). The plan states that certain occupational conditions should

have surveillance based on mandatory reporting (Kaufman and Henderson, 1996). Adult BLLs are included in the initial list of reportable conditions.

Since Registry inception, the number of blood lead reports and individuals tested has increased each year. Table B-1 shows BLLs by level for 1996 as well as cumulative through December of 1996. Since the Registry began in May 1993, 16,959 blood lead results for 12,694 Washington State adults have been received. Each year we have received more blood lead test results than each previous year, and in 1996 alone, there were 6,248 blood lead results received for over 5,400 adults. There are 1,415 (8.3%) results for 616 (4.9%) individuals with elevated BLLs (25 µg/dl and greater). Each quarter there are an average of 1,000 new adults tested for lead exposure, with an average of 22 of these individuals with elevated BLLs. Figure B-1 shows the number of reports by quarter. Over time, the number of total BLL reports received has grown substantially, while, the number of reports with elevated levels has remained relatively constant. As knowledge of the Registry and occupational lead overexposure situations grows, we continue to capture more of the population exposed to lead in the workplace.

Registry Database

The Registry is maintained in a relational database developed so that data can be entered and maintained in a form readily available for analysis.

Completeness of Reporting

Information received on laboratory reports of blood lead results varies with the laboratory submitting the report as laboratories have different reporting mechanisms. Some reporting laboratories are able to meet the full need of the Registry as outlined in the regulation, however, most provide only limited information on the reports. For instance, reports generally include the name of the patient, date of test, health care provider who ordered test, testing and reporting laboratories, and the result of the test. Less often, reports include date of birth, gender, employment information, and address information. The information collected is extremely useful in determining where problem areas exist concerning workplace lead overexposure and to ensure that overexposed individuals are properly managed. The more complete the reported data are, the more useful it makes the Registry and the less time spent on collecting the missing information.

In 1995, DOH conducted a survey of all laboratories licensed to perform toxicological testing in Washington State. There were 144 in-state laboratories and 11 out-of-state laboratories (either previously reporting blood lead results to DOH or potentially serving Washington residents) included in the survey.

Of the laboratories which conducted blood lead analyses (15%), only one laboratory stated that they were unaware of the requirement and was not reporting their results to DOH as required (Washington State DOH, 1996).

Through the use of a new data collection form which was initiated in February of 1996 (as part of the King County Lead Intervention project), one out-of-state laboratory was identified which was not reporting their results to Washington State. The laboratory, which had conducted over 540 blood lead test for Washington residents during 1996, has since provided the Registry with all available information on the tests it conducted and has developed a system for continued reporting of blood lead test results.

Confidentiality of Data

Confidentiality of patient information is protected by limiting read/write access to the Registry for only SHARP program staff with proven need to use the database. Paper lab reports and case files for the Registry are stored in locked file cabinets in the SHARP program.

The information on individual persons and employers contained within the Registry is regarded in the strictest confidence. The blood lead test results are confidential and are protected from public disclosure in any form which would identify the individual. Information on individual employers is used for SHARP's purpose of identifying industries where lead exposure reduction interventions can be targeted in order to reduce worker overexposure. SHARP does reserve the right to share information on employers with WISHA, the state Occupational Safety and Health (OSHA) plan operated by L&I, as deemed necessary to prevent serious lead overexposure situations. This only occurs when an employer has failed to demonstrate a good faith effort to address a lead overexposure situation through voluntary efforts.

Current Operations and Activities

Case Management and Follow-up Activities

The Registry's extent of case management and follow-up activities depends on an individual's BLL, with specialized protocols depending on the level (25-39, 40-59, and ≥ 60 $\mu\text{g}/\text{dl}$). A case is defined as an individual with an elevated BLL of ≥ 25 $\mu\text{g}/\text{dl}$. The main targets for follow-up activity include the individual case, employer, and health care provider. There is no follow-up for the case or employer when the BLL is less than 25 $\mu\text{g}/\text{dl}$; however, educational information on occupational lead exposure is sent to all health care providers who order blood lead tests. The Registry seeks to identify each case's employer and occupation to better characterize blood lead testing and elevated BLLs. Appendix C has a list of information available for educational follow-up activities of lead-related cases.

For each case, the health care provider is contacted in an attempt to identify the case's address, employer, occupation, as well as any information that is not found on the laboratory report itself. For cases with BLLs between 25 and 39 $\mu\text{g}/\text{dl}$, SHARP sends printed educational materials to the patient and the health care provider in order to increase awareness and understanding of lead poisoning. For cases with BLLs between 40 and 59 $\mu\text{g}/\text{dl}$, a telephone case interview is conducted to identify more specific information about the exposure situations. SHARP also sends printed educational materials to the case and health care provider. For cases with BLLs of 60 $\mu\text{g}/\text{dl}$ and greater, SHARP provides telephone occupational medicine case management consultation to the treating physician in addition to the same outreach activities carried out for cases with BLLs between 40 and 59 $\mu\text{g}/\text{dl}$. For all cases with BLL of 25 $\mu\text{g}/\text{dl}$ or greater and employment information has not yet been identified through other sources, the case is called or mailed an abbreviated interview form to identify industry and occupation of employment.

Appendix D shows results of identification and follow-up of cases and their health care providers. SHARP has sent educational information on occupational lead exposures to just over 400 cases and has conducted 74 case interviews (Table D-1). Table D-2 shows the breakdown of health care providers who ordered blood lead tests. About 15 percent of providers ($n=225$) are associated with elevated BLLs, and of these providers, few have ordered a large number of tests (16%) or have seen multiple individuals (12%). Over 825 health care providers have been sent the printed educational material to help familiarize providers with the blood lead reporting requirement in Washington State and with the medical aspects of lead overexposure.

As with case follow-up, the case's BLL also determines the extent of follow-up with the employer. For BLLs between 25 and 39 µg/dl, SHARP sends printed educational materials to the employer in order to increase awareness and understanding of lead poisoning and ways to protect employees from its harmful effects. For BLLs between 40 and 59 µg/dl, the employer may be sent a letter encouraging them to seek technical assistance to address their potential lead over-exposure situation. For BLLs of 60 µg/dl or greater, SHARP asks the employer to seek technical assistance for lead overexposure or else more stringent actions may be taken to protect workers' safety, such as referring the employer to the state occupational safety and health compliance program (WISHA). For all levels of 40 µg/dl and greater, SHARP offers telephone assistance and on-site investigations to the employer in addition to sending printed educational materials.

Follow-up with employers depends not only on available and timely information, but also on other L&I involvement with the employer. Table E-1 details information about employers of cases with elevated BLLs. There are 170 employers associated with the over 85 percent of workers with elevated BLLs for whom employers have been identified. Nearly one half of employers with elevated BLLs have BLLs >40 µg/dl. Few employers are associated with either a large number of elevated BLLs (26%) or a large number of individuals with elevated BLLs (14%).

Coordination with the King County Lead Intervention Project

The Registry supports the King County Lead Intervention project, called Adult Lead Exposure Reduction and Testing (ALERT), a two year project (10/1/95-9/30/97) which SHARP is conducting in cooperation with NIOSH. The project solicits voluntary enrollment from lead-using employers in King county (which includes the Seattle area) and encourages blood lead tests for workers in those businesses.

A data collection form directed to health care providers was developed for the ALERT project to identify participating employers and to more efficiently collect relevant employment and demographic information for workers at the time of the initial blood draw. The form is currently being piloted with selected health care providers in King County as well as neighboring Pierce and Snohomish Counties. The form collects employee information at time of blood draw which allows us to receive more complete and more accurate industry and occupation information than through our previous follow-up activities (which involved contacting the health care providers and workers for this information after the blood lead result was received). The information in the Registry allows ALERT to know which employers have conducted blood

lead testing, and which have workers with elevated BLLs--so that efforts can be made to try to reduce lead exposures. The form also captures information necessary to conduct follow-up activities if the BLL is elevated.

Use of the data collection form has allowed us to receive and ensure more complete blood lead testing information in King County. Although pilot use of the form is limited to a specific area in the state, it provides an efficient tool to collect more accurate information. We can identify laboratories that are not reporting results by comparing the data collected through the new form to the laboratory results obtained. We have also identified health care providers who were not participating in the pilot phase as they had agreed to.

The data collection form, which was distributed in February of 1996, allows us to better identify which groups of workers are getting their blood lead tested. The majority of blood lead laboratory results matched to information collected through the new data collection form are for BLLs <25 µg/dl. Through the end of 1996, we had notice of 591 blood lead tests conducted (as identified through the data collection form) for which 536 were matched when the laboratory results were received. Some delay is expected in receiving the laboratory test results due to differing laboratory reporting methods and time frames. Of the individuals completing a data collection form, 20 percent (n=187) had elevated BLLs. This information is extremely useful in the ALERT project because it helps identify which of the high-risk employers enrolled in the project may have lead exposure situations which need to be managed.

Currently the data collection form is being piloted in a selected area around King County. The overall usage and response to the form has been positive. In the future, it may be possible to expand the use of the form to other selected areas where the majority of blood lead testing occurs. Although blood lead tests are ordered by many health care providers across the state, relatively few providers actually order the majority of all tests performed. Therefore, the possibility of expanding the data collection form to other providers that order a number of blood lead tests is encouraging.

Identifying Industries and Occupations with Lead Exposures

Industries

Information on the occupational settings of cases with elevated BLLs is obtained through either health care provider records, the data collection form being piloted with selected health care providers, or through

direct contact with the case during the case interview. Table F-1 details the identified industries where cases work. Those representing the highest proportion of cases include Electric Equipment, including battery manufacturing (14.0% of the 1415 elevated BLLs or 199 reports); Glass Products, including glass manufacturing using leaded glass (13.6% or 192 reports); Construction and Special Trade Construction, representing heavy building construction as well as trades such as painting, sandblasting, and asbestos abatement (9.1% or 129 reports and 7.3% or 104 reports respectively); Transportation Equipment, including some radiator repair, shipbuilding, airplane manufacture (6.9% or 98 reports); Chemical Products, including fertilizer and ammunition manufacture (7.2% or 102 reports); Auto Repair and Services, representing radiator repair shops (8.7% or 123 reports); and Primary Metal, including foundries or other metal companies (5.6% or 79 reports). These industries represent about 72 percent of all the elevated BLLs. We were unable to identify industry information for about 14 percent of the BLLs while another 14 percent of reported BLLs represented approximately 30 other industrial categories.

For the industrial classifications with the greatest number of elevated BLLs, Figures F-1 through F-8 display information for industrial sector by BLL and for 2 digit standard industrial classification (SIC) code by quarter. The manufacturing sector alone comprises nearly one half of all elevated BLL and combined with the construction sector represents about 65 percent of all elevated BLLs (Figure F-1). The majority of the BLLs (70%) for the five most recorded sectors are levels between 25 and 39 µg/dl. Time trends for the industries (by 2 digit SIC code) associated with the largest number of elevated BLLs are shown in Figures F-2 through F-8. The trends are relatively steady by quarter with a few notable exceptions. The regular increases and decreases correspond to routine testing on a scheduled basis. There is a dramatic increase during the middle of 1994 for the heavy construction industry which is most likely associated with the changes in the lead in construction standard as it applied to blood lead testing.

The information available represents only the working population using lead which have had blood lead testing, such as through employer-sponsored lead monitoring programs. We know that only a small proportion of employers do such monitoring. A survey in California identified that only 2.6 percent of lead-using employers had done environmental sampling and only 1.4 percent had routine biological monitoring programs (Rudolph et al., 1990). In Washington State, a survey of non-construction, lead-using employers identified that 21 percent of the employers had conducted air sampling and 17 percent had conducted blood lead testing (Nelson and Kaufman, submitted).

We also know that the lead biomonitoring that is conducted is most often done by larger and more financially well-off employers. These are also the companies which often are best able to control their lead exposure hazards, so we are potentially missing some of the worst exposure situations because we are not capturing many of the smaller shops which use lead. For instance, the California survey identified that 80 percent of battery manufacture workers had been monitored (probably fairly large operations or companies) while only 1 percent of radiator-repair workers had been monitored. Radiator shops are an example of a population that is probably largely being missed by the registry because these employers are often small and do not conduct biological monitoring for lead (Rudolph et al., 1990 and Papanek Jr. et al., 1992).

Many lead-exposed workers are not tested for blood lead; therefore, our data probably represent a large underestimate of the problem of elevated BLLs in the workplace. Although the Registry is only able to obtain information on a small proportion of lead-exposed workers (those which have their BLL monitored and have been identified in the Registry), the information we collect is extremely useful in providing direction for resource use. For instance, we have done a great deal of educational outreach to workers, employers, and health care providers. We have also identified industries and workplaces with potential lead exposure problems, which assists in the overall effort of preventing occupational lead exposures.

Occupations

Information on occupation, as with industry, is obtained for cases with elevated BLL either through health care provider records, the data collection form being piloted with selected health care providers, or through direct contact with the case during the case interview. Most often this information is obtained either through the pilot data collection form or a case interview, as many health care providers do not routinely record this information.

Table G-1 shows the identified occupations in which cases work. Those representing the highest proportion of elevated BLLs include: Machine Operators, Assemblers, and Inspectors, including battery assemblers, welders, fishing weight manufacturers and machine operators (29% of 804 elevated BLLs or 234 reports); Mechanics and Repairers, including radiator repairmen and industrial machine maintenance (20% or 157 reports); Construction Trades, including painters, sandblasters, and glaziers (13% or 101 reports); and Technical and Related Support, including battery and glass technicians (11% or 92 reports).

Collecting information on case occupation is a fairly recent addition to the Registry. During 1996 we began to regularly collect this information when available for BLL ≥ 25 $\mu\text{g/dl}$. Since the collection and coding of occupation information started after the Registry began, we have missed compiling that information for some of the cases in the first few years of the Registry. However, for some cases we have been able to retroactively identify job descriptions and record them in the Registry to make the information on occupation more complete. The information on occupation provides us with another resource for identifying where lead overexposures are occurring and helps in developing ways to prevent such exposures.

Evaluation and Future Directions

Effectiveness of the Registry as a Disease Surveillance Tool

SHARP examined the effectiveness of the overall blood lead surveillance system--how it works and its results. The attributes discussed were drawn from the Centers for Disease Control and Prevention list of items that should be considered when evaluating a surveillance system (CDC, 1988). The seven attributes used to evaluate the effectiveness of a system as a surveillance tool include simplicity, flexibility, acceptability, sensitivity, predictive value positive, representativeness, and timeliness. In general, the blood lead reporting system in Washington State is simple and straightforward in the sense that it requires the relatively few laboratories which conduct blood lead analyses to report the results for residents of all ages. The system has remained flexible enough to incorporate new aspects of the reporting and recording procedures such as different report formats and reporting frequencies of laboratories. Due to widely varying estimates by laboratories as to the resources the reporting rule requires, DOH conducted a survey of the laboratories. The results of the survey are reported elsewhere (Washington State DOH, 1996).

The ability of a system to reflect the true rate of disease in a population, called sensitivity, is affected by the proportion of people with the disease who seek medical treatment [data reported elsewhere suggest relatively few workers exposed to lead are tested for blood lead (Rudolph et al., 1990)], the proportion of cases who are accurately diagnosed [the analytic test for blood lead concentrations is very good], and the proportion of diagnosed cases that are reported to the registry [most laboratories report blood lead results as required (Washington State DOH, 1996)]. The Registry's sensitivity is fairly good based on accurately diagnosed and reported cases; however, it is well known that there is probably a large proportion of exposed individuals who do not have their blood lead tested. The predictive value positive is the proportion of people reported with elevated BLLs who really have elevated BLLs. On occasion we identify people who have an erroneous BLL reported; however, the Registry's predictive value positive is generally considered to be very good.

The Registry may not be representative of all Washington workers in that most workers from small companies, which may have relatively poor industrial hygiene practices because of fiscal constraints and therefore possibly higher BLLs, are rarely tested for blood lead concentrations (Rudolph et al., 1990 and Papanek Jr. et al., 1992). In general, the laboratory results are received by DOH and the results for adults

forwarded to SHARP in a timely manner except in the cases of elevated BLLs where the results do not appear to be expedited (as the regulation requires).

Effectiveness of the Registry in Prevention of Lead Overexposure and Poisoning

L&I is increasing its efforts to educate employers on lead hazards because of the extent of worker lead exposure in the state. The Registry will be used to measure the "effectiveness" of L&I's efforts toward prevention of lead overexposures. The agency is unable to measure air lead levels in all businesses of interest because of expense and lack of personnel. The Registry, however, serves as a passive monitoring approach which requires fewer fiscal and personnel resources to collect and manage information on the BLLs of workers. As more employers become aware of the health hazards of lead and Washington's lead regulations, air and blood lead monitoring should increase. The Registry can be used to monitor this increase in prevention-related activities.

As the Registry collects more information on worker BLLs, we are able to better understand where and how workplace lead overexposures are occurring. Aside from gaining knowledge of the industries and occupations that may have problems with lead overexposures, we are able to work with specific employers to address their concerns and to increase their knowledge of lead exposures. We have conducted several site visits and mailed information to numerous other employers in an effort to help address concerns related to lead.

The Registry also provides useful information on which to base intervention projects to help protect workers' health. For instance, the Registry supports the King County Lead Intervention project which works with employers in a defined geographic area to raise awareness of the hazards of lead and assist in identifying ways to reduce the potential exposure from such hazards. Ultimately, linking health surveillance through the Registry with hazard surveillance could lead to the elimination of occupational lead poisoning (Kaufman et al., 1994).

The intervention efforts are always conducted in a voluntary setting involving SHARP, the employer, and the workers. Although located within L&I, SHARP is independent of the compliance activities of the agency.

The Registry is maintained by one full-time epidemiologist with part-time contributions by personnel at differing degrees of involvement, including an additional epidemiologist, an industrial hygienist, a data entry operator, and an occupational medicine physician.

Improving the Registry

SHARP currently has a two-part federal cooperative agreement from NIOSH (U60/CCU008413-02) to conduct surveillance and interventions related to occupational lead overexposure. The Registry is a central part of this awards. One part, for \$22,000 annually for federal fiscal years 1996-2000, enhances the follow-up activities currently conducted by SHARP. The second part, which totals over \$110,000 for the initial year and extension (fiscal years 1996-1997), is for an employer-targeted intervention project in King County. These grants ensure that even more resources will be dedicated to education and prevention activities focused towards workers with lead overexposure, to their co-workers who may also be exposed to lead, and to their workplaces in general.

Increased Use of the New Data Collection Form

As previously described, a data collection form was developed for and is being piloted as a part of the King County Lead Intervention project. This instrument for collecting industry, occupation, and other pertinent information has proved to be extremely valuable to SHARP's intervention and follow-up efforts.

Currently, the data collection form has been supplied to a selected network of health care providers in King, Snohomish, and Pierce Counties. Upon further evaluation of the form, it may be distributed to a broader network of health care providers around the state.

Quality Assurances for Laboratory Reporting

The new data collection form provides information that in the past was not easily accessible to the Registry. With knowledge that testing has occurred, we are able to identify when laboratories are not reporting their blood lead results. Once such example was previously described in this report when a laboratory conducted a large proportion of testing for Washington residents but was unaware of their obligation to report the results.

Standardized Coding of Industry and Occupation Information

Information on industry and occupation is collected for cases with elevated BLLs. This information allows us to better characterize working environments where lead overexposure may be occurring. The information obtained is coded using nationally developed coding systems. SIC codes are used to code

industry and Bureau of Census (BOC) codes are used to code occupation. Using standardized methods for coding, the Registry's data are more easily analyzed and are comparable to other systems around the country.

Targeting Follow-up Activities

The information collected by the Registry is useful in targeting follow-up activities for specific purposes. For instance, this information helps us ensure that workers with elevated BLLs have appropriate medical care, the health care providers are knowledgeable of workplace lead exposures, and the workplaces are aware of and addressing potential lead overexposure situations.

Conclusion

The Registry is an extremely valuable resource to the public health of Washington State workers. It serves a vital role as it systematically collects, analyzes, and uses blood lead laboratory results to identify problem areas for lead overexposures in the workplaces. Education and prevention efforts directed towards workers, workplaces, industries, and occupations stem directly from the information obtained through the Registry. Occupational lead exposure is a preventable condition, and the Registry is a useful tool to target resources for prevention more efficiently.

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Appendix A

Blood Lead Reporting Regulation

WAC 246-100-042 Reporting of blood lead levels.

(1) Pursuant to WAC 246-100-041, the state health officer finds as follows:

(a) Adverse health effects resulting from elevated levels of lead in the blood has been acknowledged as a public health concern throughout the United States;

(b) Epidemiologic investigation based on reports of the results of blood level tests may contribute to the understanding of the condition, its prevalence within the state of Washington, and especially the extent to which the condition affects both children and those who may be exposed to lead in the work place;

(c) Rapid follow-up and appropriate management of potentially hazardous blood lead levels is necessary to assure safe public health, and assists in development of programs to prevent future lead over-exposure.

(2) Definitions. For the purposes of this section, the following words and phrases have the following meanings:

(a) "Blood lead level" means a measurement of lead content in whole blood.

(b) "Reporting organization" means any medical laboratory which performs blood lead analysis at a site within the state of Washington; or any individual or organization which sends blood specimens to an out-of-state medical laboratory for lead testing, including in-state organizations which receive blood specimens from other in-state individuals or organizations, and then send those specimens to an out-of-state testing laboratory.

(c) "Testing laboratory" means a medical laboratory which performs a blood lead analysis.

(3) Reporting of blood lead levels. (a) A reporting organization shall report all blood lead levels to the department of health, including those which are within normal limits. The department of health shall send a copy of any report with a blood lead level equal to or greater than 40 micrograms per deciliter in adults, or equal to or greater than 10 micrograms per deciliter in children less than 15 years of age, to the local health department serving the jurisdiction in which the tested person resides.

(b) An individual or organization which sends blood specimens to an out-of-state laboratory may fulfill its reporting obligation by arranging for the testing laboratory to submit adequate reports.

(c) Reports shall be made in a format approved by the department.

(d) For blood lead levels equal to or greater than 40 micrograms per deciliter for adults, or equal to or greater than 20 micrograms per deciliter in children less than 15 years of age, the department must be notified by telephone, fax or mail within seven calendar days of the date test was performed, or if the test was performed by an out-of-state laboratory the date when the test result was received. Telephone reports must be supplemented by a written report submitted no later than the fifth business day of the next month after the telephone contact. In event age of patient is not known, the reporting organization shall follow the reporting schedule for children less than 15 years of age.

(e) For blood lead levels equal to or greater than 20 micrograms per deciliter in adults, or equal to or greater than 10 micrograms per deciliter in children less than 15 years of age, a report shall be made to the department no later than the fifth business day of the next month after the month in which the test was performed, or if the test was performed by an out-of-state laboratory the month during which the test result was received. In the event age of patient is not known, the reporting organization shall follow the reporting schedule for children less than 15 years of age.

(f) Information to be reported to the department for blood lead levels specified in parts (3)(d) and (3)(e) shall include the following:

(i) Name of the person tested; (ii) Name of the reporting organization; (iii) Name of the testing laboratory; (iv) Date specimen received; (v) Blood lead level of person tested; (vi) Name of health care provider ordering test; (vii) Address or telephone number of health care provider ordering test, if available;

(viii) Date of birth or the age of the person tested, if available;

(ix) Sex of person tested, if available; (x) Race and ethnicity of person tested, if available; (xi) Whether blood specimen is venous or capillary, if available;

(xii) Free erythrocyte or zinc protoporphyrin or zinc protoporphyrin/heme ratio, if performed, when available;

(xiii) Address and occupation of the person tested, or if a child the parents' occupation, if available;

(xiv) Name, address and telephone number of the employer, or if a child the parents' employer, if available;

(g) For all other blood lead levels, the reporting organization must either report the information specified in (3)(f) or submit a monthly summary report by the fifth day of the next month. The monthly summary must be categorized by the number of tests performed on specimens for children less than 15 years of age, the number of tests performed for individuals 15 years of age or older and the number of tests performed where patient's age is unknown. In each category the number of tests must be sorted by one of the following geographic indicators: patient county of residence, or patient postal zip code of residence, or provider county of practice, or provider postal zip code of practice.

(4) Responsibilities of health care providers. Upon request of a representative of the department of health or the department of labor and industries, a health care provider who has ordered a blood lead test shall provide the patient's address and telephone number to the department of health or the department of labor and industries, and when known the following information:

(a) Circumstances of lead exposure; (b) Employer's name, address and telephone number, or, if a child, the same information on the employers of the parents;

(c) Occupation of person tested, or, if a child, occupation of parents;

(d) Type of industry of employer of person tested, or, if a child, type of industry of the employers of the parents;

(e) Reason for drawing lead level. (5) Confidentiality. (a) The medical laboratory report and all patient information provided by the health care provider shall be maintained in a confidential manner as with other disease reports and are not subject to public disclosure in any form under which the patient may be identified.

(b) The department of labor and industries shall have full access to information collected pursuant to this section, for the purposes of research, analysis, and follow-up of blood lead levels.

(6) This rule shall apply to tests performed for blood specimens drawn between May 15, 1996, and May 14, 1999.

[Statutory Authority: RCW 43.20.050. 96-11-077, § 246-100-042, filed 5/13/96, effective 6/13/96.

Statutory Authority: RCW 43.20.050(3). 93-10-038 (Order 358), § 246-100-042, filed 4/28/93, effective 5/29/93.]

Appendix B

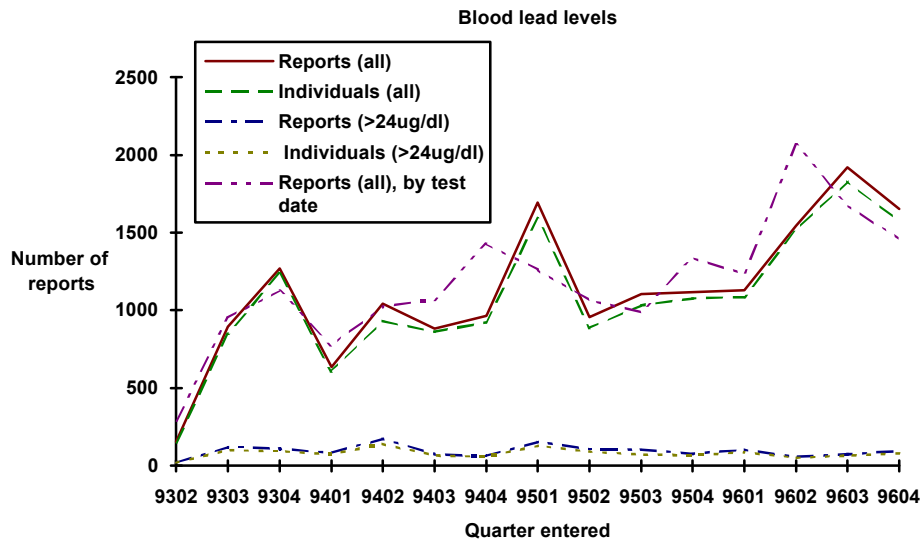
Current status of Blood Lead Level Reporting

Table B-1. Adult blood lead levels reported in Washington State.

Blood Lead	Jan. 1-Dec. 31, 1996		May 15, 1993-Dec. 31, 1996	
(µg/dl)	Reports	Individuals ^a	Reports	Individuals ^a
< 25	5918	5278	15544	12078
25-39	227	145	986	439
40-49	70	36	290	112
50-59	27	16	96	41
≥ 60	6	4	43	24
TOTAL	6248	5479	16959	12694

^aFor individuals with multiple reports, only the highest blood lead level is counted.

Figure B-1. Blood lead levels by quarter



Notes:

The dates refer to the year and quarter that the laboratory reports were entered into the Registry and correspond to reports made to the national ABLES program. This does not necessarily represent when the tests were conducted.

The all reports by test date line provides another view of temporal trends.

The dramatic peak noted in the first quarter of 1995 is a result of staffing issues concerning the Registry and not necessarily an increase in laboratory testing or reporting.

Appendix C

Informational Materials

The information materials listed below are available through SHARP and may be distributed as needed as part of follow-up activities with cases, employers, and health care providers or by direct request.

Case Studies in Environmental Medicine: Lead Toxicity by the Agency for Toxic Substances and Disease Registry (June 1990)

Employees Exposed to Lead in Washington State Workplaces Report 41-1-1996

Exposure Assessment Among Residential Painters Occupationally Exposed to Lead Report 37-1-1995

Occupational Lead Exposure--A Health Care Provider Alert Report 17-7-1994

Occupational Lead Exposure--An Alert for Workers Report 17-6-1994

Occupational Lead Exposure--An Employer Alert Report 17-8-1994

Occupational Lead Exposure Registry document describing the registry

“The Lead-Exposed Worker,” article by D. Rempel (JAMA. 1989;262:532-534)

Washington State Lead Reporting System Update, December 1993 Report 38-1-1993

Washington State Lead Reporting System Update, August 1994 Report 38-2-1994

Washington State Lead Reporting System Update, April 1995 Report 38-3-1995

Washington State Lead Reporting System Update, February 1996 Report 38-4-1996

Washington State Lead Reporting System Update, February 1997 Report 38-5-1997

Appendix D

Follow-up of Workers and Health Care Providers

Table D-1. Follow-up of workers

Case information ^a	25-39 µg/dl	40-59 µg/dl	≥ 60 µg/dl	Total
Total cases	439	153	24	616
Total cases with some address information	381	132	24	537
Cases sent information	287	101	19	407
Cases interviewed	12	46	16	74

^aInformation is listed by highest blood lead level per individual case.

Note: The 616 total individuals with elevated blood lead levels (≥ 25 µg/dl) have a combined 1415 reports which represents approximately 5 percent of the individuals in the Registry.

Table D-2. Identification of health care providers who order blood lead tests

Health care providers	number
Total number of providers identified	1536
Total number with some address information	1137
Contacted by mail with educational information	> 825
Associated with BLLs ^a ≥ 25 µg/dl	225
with ≥ 5 patients with BLLs ≥ 25 µg/dl	28
with ≥ 10 patients with BLLs ≥ 25 µg/dl	8
with ≥ 5 reports of BLLs ≥ 25 µg/dl	35
with ≥ 10 reports of BLLs ≥ 25 µg/dl	21

^aBLL: blood lead level

Appendix E

Follow-up of Employers

Table E-1. Identification of employers

Employers	number
Workers ^a with BLL ^b \geq 25 $\mu\text{g/dl}$ with employer identified	531
Workers with BLL \geq 25 $\mu\text{g/dl}$ with industry identified	498
Number of employers with workers with BLL \geq 25 $\mu\text{g/dl}$	170
Number of employers with workers with BLL \geq 40 $\mu\text{g/dl}$	78
Number of employers with workers with BLL \geq 60 $\mu\text{g/dl}$	13
Number of employers with \geq 5 reports of BLLs \geq 25 $\mu\text{g/dl}$	45
Number of employers with \geq 10 reports of BLLs \geq 25 $\mu\text{g/dl}$	24
Number of employers with \geq 5 workers of BLLs \geq 25 $\mu\text{g/dl}$	26
Number of employers with \geq 10 workers of BLLs \geq 25 $\mu\text{g/dl}$	11

^aTotal number of workers with high BLL=616

^bBLL: blood lead level

Appendix F

Distribution by Industry

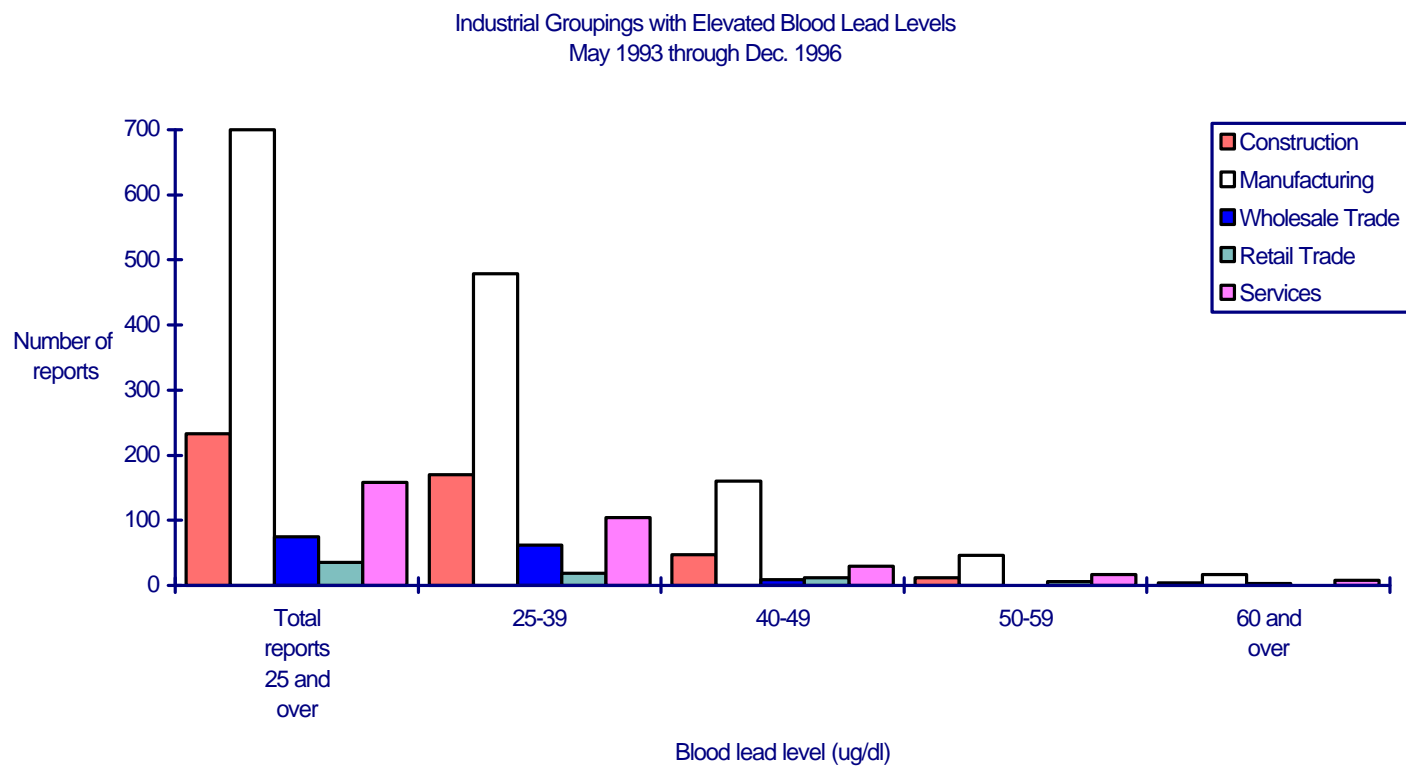
Table F-1. Industries associated with elevated blood lead levels (≥ 25 $\mu\text{g/dl}$)
May 1993 though December 1996

INDUSTRY	SIC CODE	Reports 25-39 $\mu\text{g/dl}$	Reports 40-49 $\mu\text{g/dl}$	Reports 50-59 $\mu\text{g/dl}$	Reports ≥ 60 $\mu\text{g/dl}$	Total Reports ≥ 25 $\mu\text{g/dl}$
Metal Mining	10					4
LEAD AND ZINC ORES	1031	2	0	0	0	2
GOLD ORES	1041	2	0	0	0	2
Nonmetallic Metal Mining	14					1
CONSTRUCTION SAND AND GRAVEL	1442	1	0	0	0	1
Building Construction	15					29
GENERAL CONTRACTORS - SINGLE-FAMILY HOUSES	1521	3	3	0	1	7
GENERAL CONTRACTORS - RESIDENTIAL BLDGS, OTHER THAN SING	1522	9	7	4	0	20
NONRESIDENTIAL BUILDINGS, OTHER THAN INDUSTRIAL BLDG	1542	0	0	1	1	2
Heavy Construction	16					100
HIGHWAY & STREET CONSTRUCTION, EXC ELEVATED HIGHWAYS	1611	16	6	0	0	22
BRIDGE, TUNNEL & ELEVATED HIGHWAY CONSTRUCTION	1622	4	0	0	0	4
WATER, SEWER & COMMUNICATIONS & POWER LINE CONST	1623	52	8	1	0	61
HEAVY CONSTRUCTION, NEC	1629	12	1	0	0	13
Construction-Special Trade	17					104
PLUMBING, HEATING, AND AIR-CONDITIONING	1711	4	0	1	0	5
PAINTING AND PAPER HANGING	1721	55	20	3	2	80
ELECTRICAL WORK	1731	1	0	0	0	1
MASONRY, STONE SETTING, AND OTHER STONE WORK	1741	1	1	0	0	2
PLASTERING, DRYWALL, ACOUSTICAL, & INSULATION WORK	1742	1	0	1	0	2
CONCRETE WORK	1771	1	0	0	0	1
STRUCTURAL STEEL ERECTION	1791	2	0	0	0	2
GLASS AND GLAZING WORK	1793	1	0	0	0	1
EXCAVATING WORK	1794	0	0	1	0	1
WRECKING AND DEMOLITION WORK	1795	7	1	0	0	8
SPECIAL TRADE CONTRACTORS, NEC	1799	1	0	0	0	1
Textile Mill	22					6
LACE & WARP KNIT FABRIC MILLS	2258	2	3	1	0	6
Chemical Products	28					102
INDUSTRIAL INORGANIC CHEMICALS, NEC	2819	37	1	1	0	39
NITROGENOUS FERTILIZERS	2873	54	6	1	0	61
EXPLOSIVES	2892	1	0	1	0	2
Glass Products	32					192
FLAT GLASS	3211	156	16	0	1	173
PRESSED AND BLOWN GLASS AND GLASSWARE, NEC	3229	14	3	0	0	17
POTTERY PRODUCTS, NEC	3269	2	0	0	0	2
Primary Metals	33					79
STEEL WORKS, BLAST FURNACES (INCLUDING COKE OVENS)	3312	8	1	0	0	9
GRAY AND DUCTILE IRON FOUNDRIES	3321	37	18	5	8	68
ROLLING, DRAWING, AND EXTRUDING OF NONFERROUS METALS, EX	3356	1	0	0	0	1
NONFERROUS DIE-CASTING EXC. ALUMINUM	3364	0	0	1	0	1

INDUSTRY	SIC CODE	Reports 25-39 µg/dl	Reports 40-49 µg/dl	Reports 50-59 µg/dl	Reports ≥ 60 µg/dl	Total Reports ≥ 25 µg/dl
Fabricated Metal Products	34					5
HAND AND EDGE TOOLS, EXC MACHINE TOOLS & HANDSAWS	3423	2	0	0	0	2
COATING ENGRAVING, AND ALLIED SERVICES, NEC	3479	3	0	0	0	3
Industrial & Commercial Machinery	35					1
INDUSTRIAL & COMMERCIAL MACHINERY & EQUIPMENT, NEC	3599	1	0	0	0	1
Electric Equipment	36					199
STORAGE BATTERIES	3691	77	87	31	4	199
Transportation Equipment	37					98
MOTOR VEHICLE PARTS & ACCESSORIES	3714	50	17	3	0	70
TRUCK TRAILERS	3715	0	1	0	0	1
AIRCRAFT PARTS AND AUXILIARY EQUIPMENT, NEC	3728	2	0	0	0	2
SHIP BUILDING & REPAIRING	3731	22	2	0	1	25
Measuring, Analyzing, & Medical Equip.	38					7
SEARCH, NAVIGATION, AERONAUTICAL & NAUTICAL SYSTEM	3812	6	0	0	0	6
SURGICAL & MEDICAL INSTRUMENTS & APPARATUS	3841	0	1	0	0	1
Manufacturing Industries (misc.)	39					11
SPORTING AND ATHLETIC GOODS, NEC	3949	3	4	2	2	11
Motor Freight Transport & Warehousing	42					1
TRUCKING, EXCEPT LOCAL	4213	1	0	0	0	1
Water Transportation	44					1
TOWING AND TUGBOAT SERVICE	4492	1	0	0	0	1
Electric, Gas, & Sanitary Services	49					2
ELECTRIC SERVICES	4911	2	0	0	0	2
Wholesale Trade-Durable Goods	50					73
MOTOR VEHICLE SUPPLIES AND NEW PARTS	5013	4	0	0	0	4
METALS SERVICE CENTERS & OFFICES	5051	35	3	0	0	38
ELECTRICAL APPARATUS & EQUIPMENT	5063	2	1	0	0	3
INDUSTRIAL MACHINERY & EQUIPMENT	5084	5	0	0	0	5
SCRAP & WASTE MATERIALS	5093	15	5	0	3	23
Wholesale Trade-Nondurable Goods	51					1
FARM PRODUCT RAW MATERIALS, NEC	5159	1	0	0	0	1
Food Stores	54					2
GROCERY STORES	5411	2	0	0	0	2
Auto Dealers & Gas Service Stations	55					24
AUTO & HOME SUPPLY STORES	5531	12	5	2	0	19
GASOLINE SERVICE STATIONS	5541	0	3	2	0	5
Miscellaneous Retail	59					9
SPORTING GOODS STORES AND BICYCLE SHOPS	5941	4	3	2	0	9
Depository Institutions	60					1
FEDERAL RESERVE BANKS	6011	1	0	0	0	1
Nondepository Institutions	61					1
SHORT-TERM BUSINESS CREDIT INSTITUTIONS, EXC AGRI	6153	1	0	0	0	1
Real Estate	65					1
OPERATORS OF APARTMENT BUILDINGS	6513	1	0	0	0	1
Business Services	73					5
HELP SUPPLY SERVICES	7363	0	1	0	0	1
DETECTIVE, GUARD, AND ARMORED CAR SERVICES	7381	1	1	0	0	2
BUSINESS SERVICES, NEC	7389	2	0	0	0	2

INDUSTRY	SIC CODE	Reports 25-39 µg/dl	Reports 40-49 µg/dl	Reports 50-59 µg/dl	Reports ≥ 60 µg/dl	Total Reports ≥ 25 µg/dl
Auto Repair and Services	75					123
AUTO EXHAUST SYSTEM REPAIR SHOPS	7533	1	0	0	0	1
GENERAL AUTOMOTIVE REPAIR SHOPS	7538	1	0	0	0	1
AUTOMOTIVE REPAIR SHOPS, NEC	7539	76	20	17	8	121
Miscellaneous Repair Services	76					8
WELDING REPAIR	7692	1	0	0	0	1
REPAIR SERVICES AND RELATED SERVICES, NEC	7699	3	4	0	0	7
Amusement and Recreation Services	79					7
AMUSEMENT & RECREATION SERVICES, NEC	7999	6	1	0	0	7
Health Services	80					2
OFFICES ANC CLINICS OF DOCTORS OF MEDICINE	8011	1	0	0	0	1
GENERAL MEDICAL & SURGICAL HOSPITALS	8062	1	0	0	0	1
Educational Services	82					2
ELEMENTARY & SECONDARY SCHOOLS	8211	1	0	0	0	1
COLLEGES, UNIVERSITIES, & PROFESSIONAL SCHOOLS	8221	1	0	0	0	1
Engineering Services	87					10
ENGINEERING SERVICES	8711	4	0	0	0	4
TESTING LABORATORIES	8734	4	2	0	0	6
Services, Not Elsewhere Classified	89					1
SERVICES, NEC	8999	1	0	0	0	1
Executive, Legislative, & General Govt.	91					1
GENERAL GOVERNMENT, NEC	9199	1	0	0	0	1
Justice, Public Order, & Safety	92					1
CORRECTIONAL INSTITUTIONS	9223	1	0	0	0	1
Administration of Economic Programs	96					4
REGULATION, ADMIN. OF TRANSPORTATION PROGRAMS	9621	0	3	1	0	4
National Security & International Affairs	97					3
NATIONAL SECURITY	9711	3	0	0	0	3
Other		16	5	0	0	21
Unknown		121	26	14	12	173
TOTAL		986	290	96	43	1415

Figure F-1. Industrial groupings



Figures F-2 through F-8 Time trends by industry

Notes:

Data shown are for elevated BLLs only.

The dates refer to the year and quarter that the laboratory reports were entered into the Registry. This does not necessarily represent when the tests were conducted.

In general, a decrease at the end of 1994 and an increase at the beginning of 1995 was probably more related to internal staffing issues with the Registry than to changes in blood lead testing patterns.

Figure F-2.

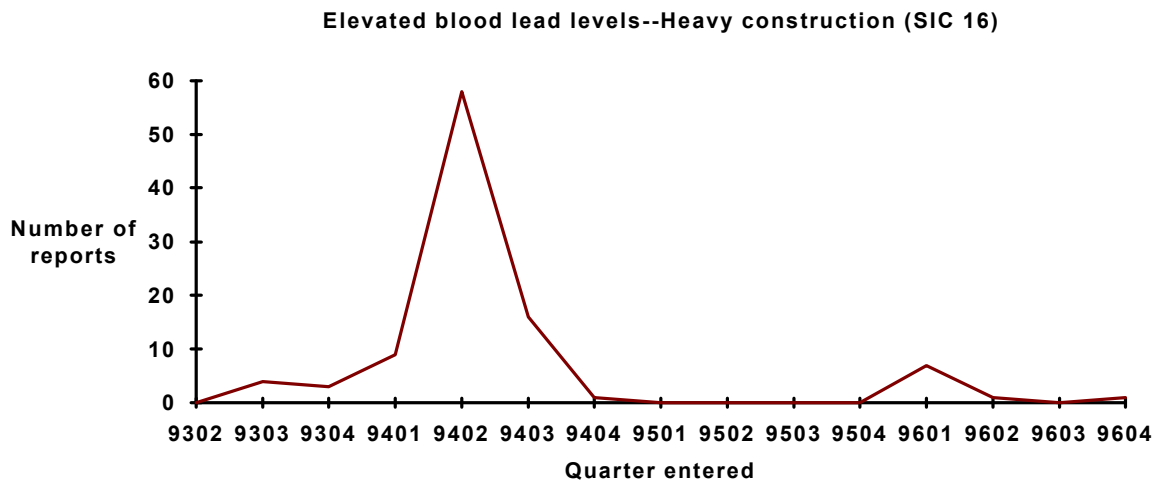


Figure F-3

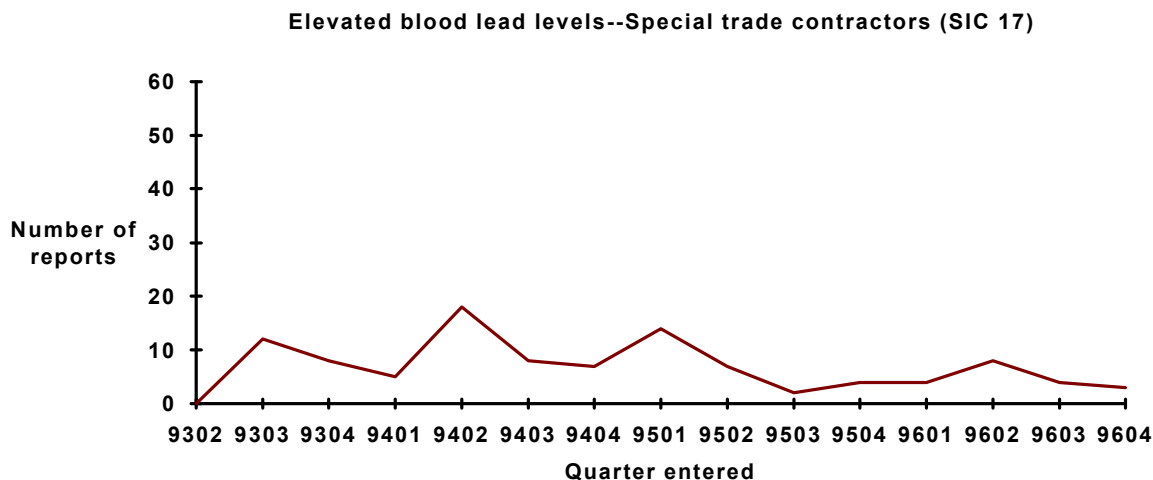


Figure F-4

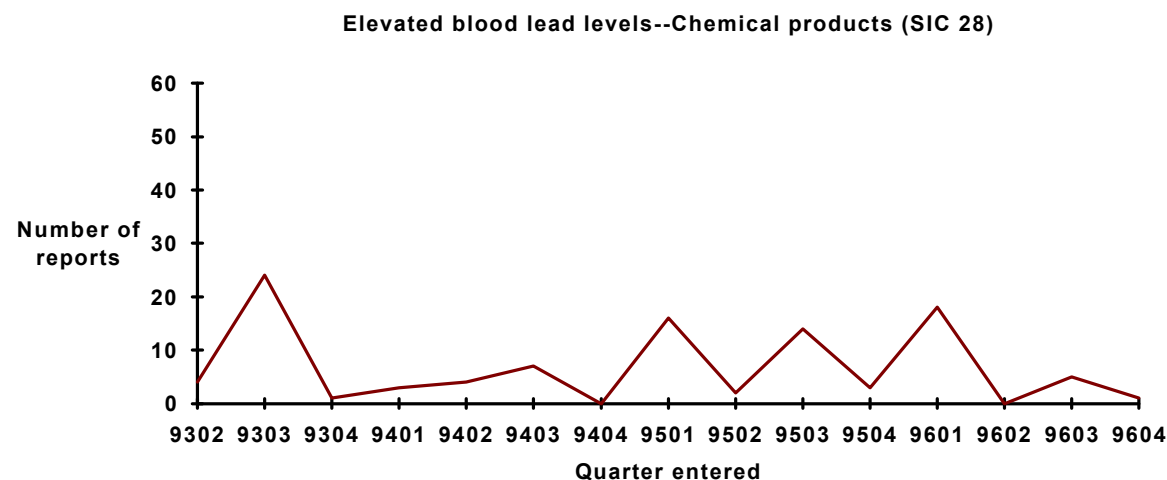


Figure F-5.

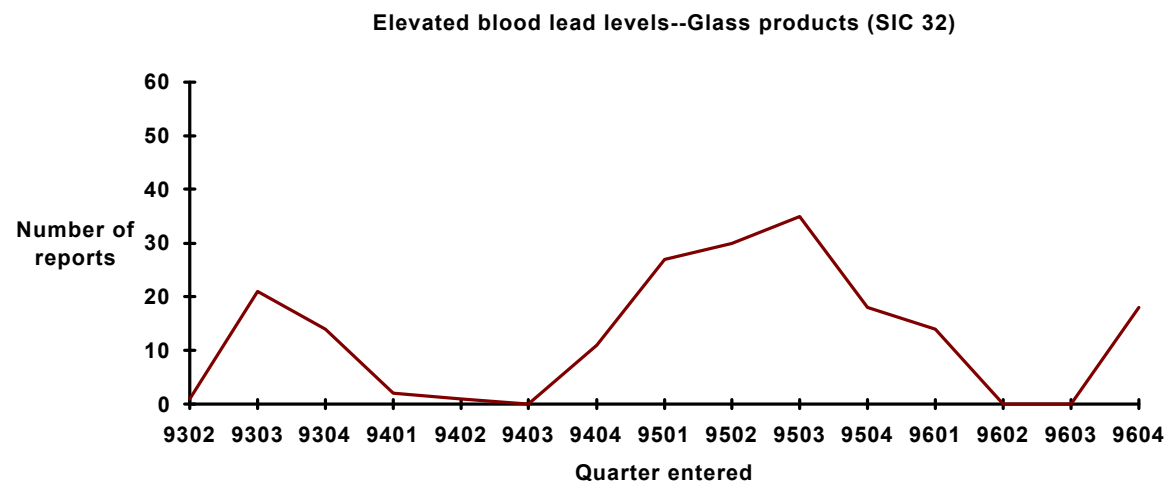


Figure F-6.

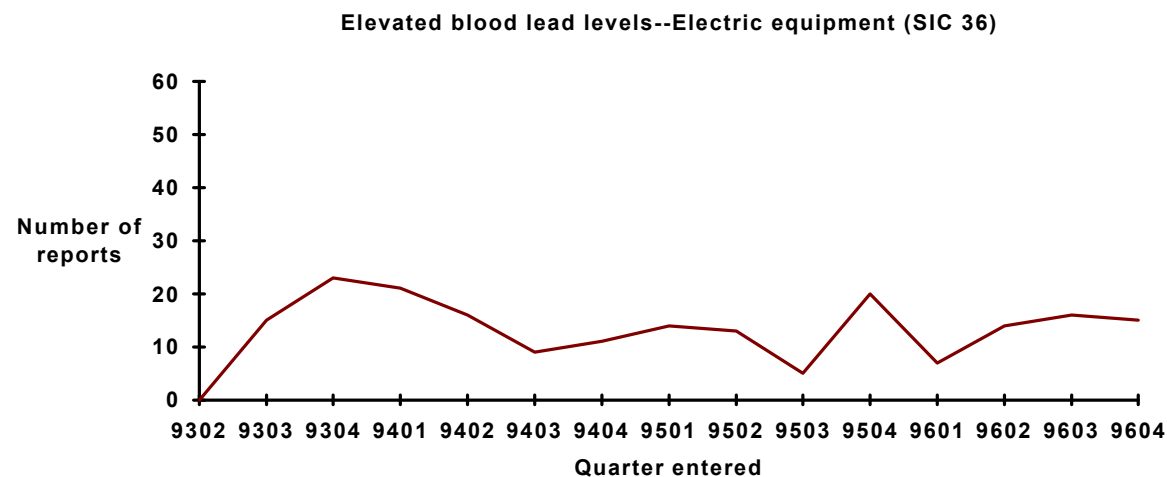


Figure F-7.

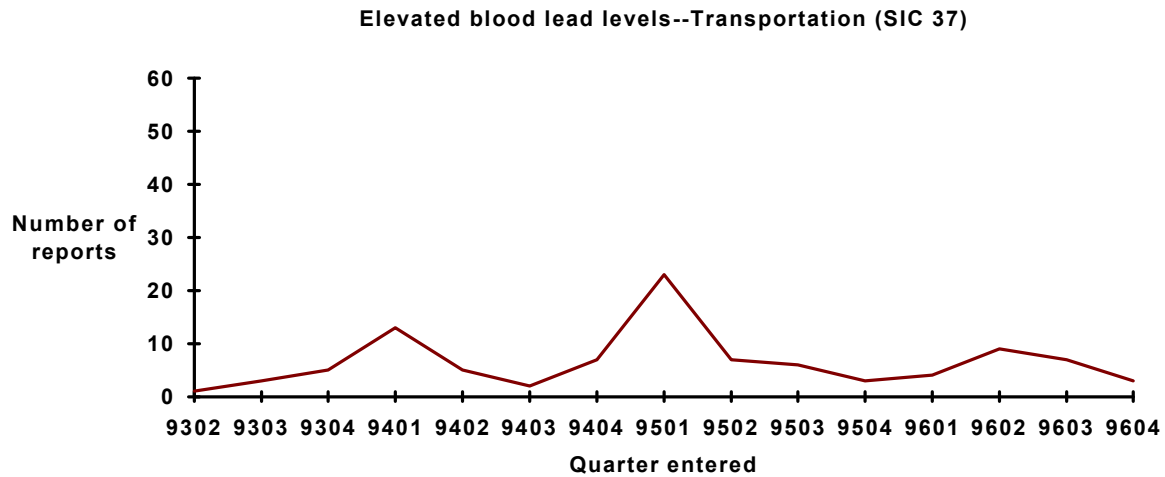
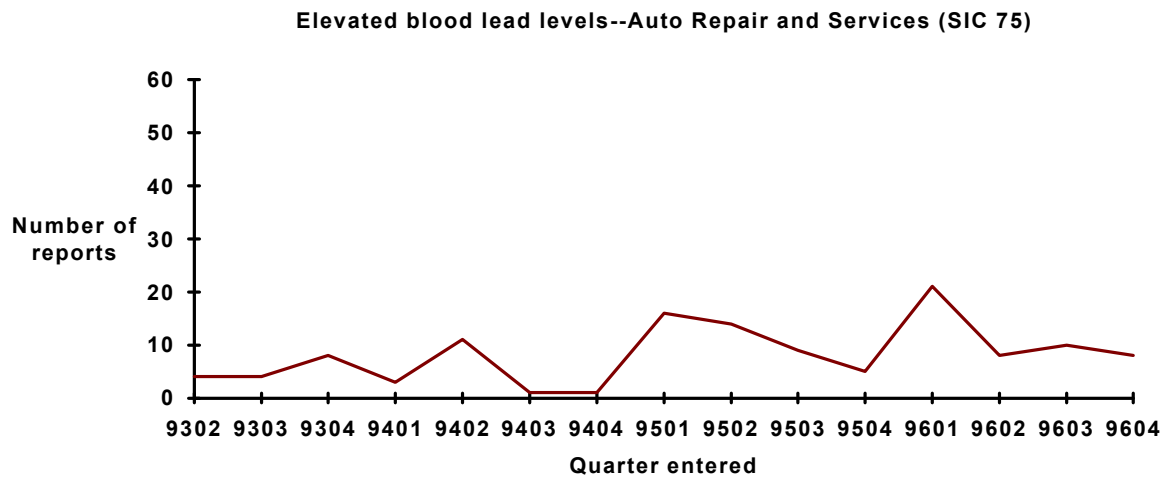


Figure F-8.



Appendix G

Distribution by Occupation

Table G-1. Occupations associated with elevated blood lead levels ($\geq 25 \mu\text{g/dl}$)
May 1993 though December 1996

Census Occupation Code	OCCUPATION	Reports 25-39 $\mu\text{g/dl}$	Reports 25-39 $\mu\text{g/dl}$	Reports 40-59 $\mu\text{g/dl}$	Reports ≥ 60 $\mu\text{g/dl}$	Total Reports $\geq 25 \mu\text{g/dl}$
003-199	Managerial and Professional Specialty Occupations					24
003-037	EXECUTIVE, ADMINISTRATIVE, AND MANAGERIAL OCCUPATIONS	6	0	0	0	6
043-199	PROFESSIONAL SPECIALTY OCCUPATIONS	13	3	2	0	18
203-389	Technical, Sales, and Administrative Support Occupations					110
203-235	TECHNICAL AND RELATED SUPPORT OCCUPATIONS	91	1	0	0	92
243-285	SALES	16	0	0	0	16
303-389	ADMINISTRATIVE SUPPORT OCCUPATIONS INCLUDING CLERICAL	0	1	0	1	2
403-469	Service Occupations					2
413-427	PROTECTIVE SERVICE OCCUPATIONS	1	1	0	0	2
503-699	Precision Production, Craft, and Repair Occupations					348
503-549	MECHANICS AND REPAIRERS	97	32	21	7	157
553-599	CONSTRUCTION TRADES	70	20	9	2	101
628-655	PRECISION PRODUCTION OCCUPATIONS	62	18	3	0	83
666-674	PRECISION TEXTILE, APPAREL, AND FURNISHINGS MACHINE WORKERS	2	3	1	0	6
689-699	PLANT AND SEWAGE OPERATORS	1	0	0	0	1
703-889	Operators, Fabricators, and Laborers					320
703-799	MACHINE OPERATORS, ASSEMBLERS, AND INSPECTORS	121	79	28	6	234
803-859	TRANSPORTATION AND MATERIAL MOVING OCCUPATIONS	31	7	0	0	38
864-889	HANDLERS, EQUIPMENT CLEANERS, HELPERS, AND LABORERS	29	10	3	6	48
	TOTAL	540	175	67	22	804